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ACT-America: Gridded Ensembles of Surface Biogenic Carbon Fluxes, 2003-2019

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Documentation Revision Date: 2020-09-27

Dataset Version: 1.1

Summary

This data set provides gridded, model-derived gross primary productivity (GPP), ecosystem respiration (RECO), and net ecosystem exchange (NEE) of CO₂ biogenic fluxes and their uncertainties at monthly and 3-hourly time scales over 2003-2019 on a 463-m spatial resolution grid for the conterminous United States (CONUS) and on both 5-km and half-degree spatial resolution grids for North America (NA). The biogeochemical model Carnegie Ames Stanford Approach (CASA) was used.

There are 762 files in NetCDF version 4 format with this dataset. This includes 462 files containing ensemble members of each carbon flux and 300 files that are the mean and standard deviation across ensemble members.

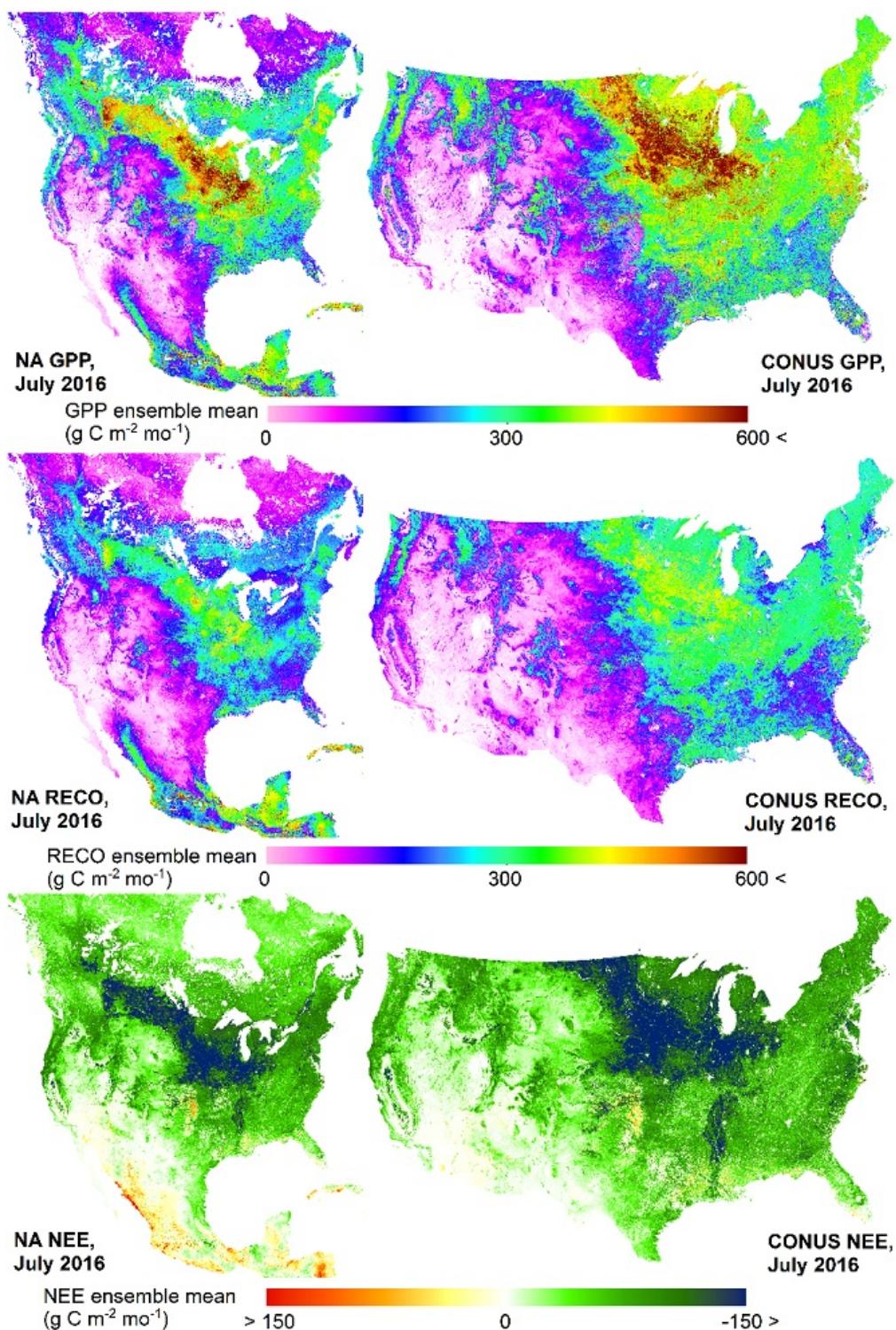


Figure 1. Mean and standard deviation of CASA L2 ensembles for three carbon fluxes (GPP, RECO, and NEE) and at 463-m resolution for the conterminous US (CONUS) and at 5-km resolution for North America (NA) in July of 2016.

Citation

Zhou, Yu, C.A. Williams, T. Lauvaux, S. Feng, I.T. Baker, Y. Wei, A.S. Denning, K. Keller, and K.J. Davis. 2019. ACT-America: Gridded Ensembles of Surface Biogenic Carbon Fluxes, 2003-2019. ORNL DAAC, Oak Ridge, Tennessee, USA.
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Table of Contents

1. Dataset Overview
2. Data Characteristics
3. Application and Derivation
4. Quality Assessment
5. Data Acquisition, Materials, and Methods
6. Data Access
7. References
8. Dataset Revisions

1. Dataset Overview

This dataset contains the second-level (L2 and L2B) ensemble member estimates of surface biogenic CO₂ exchanges between land and atmosphere across portions of North America, including three carbon fluxes: gross primary productivity (GPP), ecosystem respiration

(RECO), and net ecosystem exchange (NEE) (Zhou et al., 2020). Carbon flux ensembles were derived from Carnegie Ames Stanford Approach (CASA) biogeochemical model (Potter et al. 1993; Randerson et al. 1996) with 27 perturbed parameter sets. This product contains carbon fluxes for two spatial domains, the conterminous United States and North America and at two temporal scales, monthly and 3-hourly.

Project: Atmospheric Carbon and Transport (ACT-America)

The ACT-America, or Atmospheric Carbon and Transport - America, project was a NASA Earth Venture Suborbital-2 mission to study the transport and fluxes of atmospheric carbon dioxide and methane across three regions in the eastern United States. ACT-America conducted five flight campaigns spanning all four seasons throughout 2016–2019 and measured how weather systems transported greenhouse gases. Ground-based measurements were also collected. The objective of the study was to enable more accurate and precise estimates of the sources and sinks of greenhouse gases, as better estimates are needed for climate management and for prediction of future climate. Three primary sources of uncertainty (i.e., transport error, prior flux uncertainty, and limited data density) were addressed to improve the inference of carbon dioxide and methane sources and sinks.

Related Publication:

Zhou, Y., C. A. Williams, T. Lauvaux, K. J. Davis, S. Feng, I. Baker, S. Denning, & Y. Wei. 2020. A multiyear gridded data ensemble of surface biogenic carbon fluxes for North America: Evaluation and analysis of results. *Journal of Geophysical Research: Biogeosciences*, 125(2), e2019JG005314. <https://doi.org/10.1029/2019JG005314>

Acknowledgements:

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2. Data Characteristics

Spatial Coverage: Conterminous United States (CONUS); North America (NA)

Spatial Resolution: 463 m (CONUS); 5 km and half-degree (NA)

Temporal Coverage: 2003-01-01 to 2019-12-31

Temporal Resolution: Monthly and 3-hourly (3-hourly data is available for North America domain in 2016-2019; other temporal and spatial spans can be generated by the provided R script)

Site boundaries: (All latitudes and longitudes are given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
CONUS	-130.1748	-60.5999	55.3236	20.0276
NA	-175.5350	-24.7704	70.3800	0.7843
NA_HalfDeg	-176	-24.5	70.5	0.5

Data Description

There are 762 files in netCDF version 4 (*.nc4) format: 462 files (210 monthly and 252 3-hourly files) containing ensemble members of each carbon flux and 300 files are the mean and standard deviation across ensemble members.

File Naming Convention

CASA_LEVEL_Engsemble_TIMESCALE_Biogenic_CARBONFLUX_SPATIALDOMAIN_YEARMONTH.nc4

CASA_LEVEL_Engsemble_STATISTIC_TIMESCALE_Biogenic_CARBONFLUX_SPATIALDOMAIN_YEARMONTH.nc4

where

CASALEVEL is the level of data product, we currently provide Level-2 (L2) and Level-2B (L2B).

TIMESCALE is either monthly or 3-hourly.

STATISTIC is the mean (Mean) or standard deviation (STD) across ensemble members.

CARBONFLUX is GPP, RECO or NEE.

SPATIALDOMAIN is either CONUS or NA.

YEAR is the year of simulation.

MONTH is a simulated month used for 3-hourly files only.

Data File Details

CONUS files are at a 463-m spatial resolution, NA files are at a 5-km spatial resolution, and NA_HalfDeg (upscaled NA) files are at half-degree spatial resolution. The time dimension is defined as the middle time point of each time period (e.g., 15th day of Marches for monthly files; 1.5 hours of the first three-hour for 3-hourly files).

Fill value and missing values are -9999 for all files.

CONUS

projection: Lambert Conformal Conic

projection units: meters

datum (spheroid): GRS_1980

semi major Axis: 6378137.0

semi minor Axis: 6356752.314140356

inverse Flattening: 298.257222101

1st standard parallel: 50 deg N

2nd standard parallel: 50 deg N

central meridian: -107 deg W

latitude of origin: 50 deg N

false easting: 0

false northing: 0

NA

projection: Lambert Conformal Conic 2SP

projection units: meters

datum (sphere): GCS_unnamed_ellipse (from NARR data)

semi major Axis: 6371200.0
semi minor Axis: 6371200.0
inverse Flattening: 0.0
1st standard parallel: 50 deg N
2nd standard parallel: 50 deg N
central meridian: -107 deg W
latitude of origin: 50 deg N
false easting: 0
false northing: 0

NA_HalfDeg

projection: WGS 1984
angular Unit: Degree (0.0174532925199433)
prime Meridian: Greenwich (0.0)
datum: D_WGS_1984
semi major Axis: 6378137.0
semi minor Axis: 6356752.314245179
inverse Flattening: 298.257223563

Companion Files

TemporalDownscaling.zip

These files are ancillary data from the 3-hourly NARR dataset (<https://rda.ucar.edu/datasets/ds608.0/index.html#!description>) to use with the script TemporalDownscaling.R.

The file naming convention for yearly directories is NARR_YEARMONTH_3h_FACTOR.tif

where

YEAR is the year for temporal downscaling.

MONTH is selected month, which only used for 3-hourly data

FACTOR is either dsws (downward shortwave radiation) or airt (air temperature at 2-m height).

RandomEcoregionalSampling.zip

These files are gridded data to use with the script L2B_SampleEcoregions.R.

The file naming convention is SPATIALDOMAIN_Eco_CASALEVEL_CASAGrid.nc4

where

SPATIALDOMAIN is either CONUS or NA.

CASALEVEL is the level of data product, Level-1 to Level-4.

3. Application and Derivation

This dataset is at a finer spatial resolution and a relatively longer time span than similar products. It could be used to access surface biogenic carbon fluxes across multiple spatial (hundred meters to continental) and temporal (hourly to annual) scales can give an indication of carbon cycle processes under different weather patterns and feedback to climate change. The ensemble data provide not only carbon flux estimates but also uncertainty range, and could serve as prior surface biogenic carbon fluxes for atmospheric inversion studies.

4. Quality Assessment

To test and confirm the accuracy of our monthly ensemble, the assessment was evaluated by a set of ground-truth data of measured carbon fluxes from the AmeriFlux database (sites are listed in Table 1) and other carbon flux products including 3-hourly MSTMIP modeled ensemble (Huntzinger et al. 2013; Fisher et al. 2016; Huntzinger et al. 2016), CarbonTracker 2017 (CT2017, Peters et al. 2007), SiB3 (Baker et al. 2008; Baker et al. 2013) from 2006 to 2010. See Zhou et al. (2020) for additional information.

Table 1. List of AmeriFlux tower sites used in the quality assessment.

Site ID	Start Year	End Year	Lat	Lon	IGBP	Reference
US-AR1	2009	2012	36.4	-99.4	GRA	Billesbach et al. 2016a
US-AR2	2009	2012	36.6	-99.6	GRA	Billesbach et al. 2016b
US-ARB	2005	2006	35.5	-98.0	GRA	Torn 2006a
US-ARC	2005	2006	35.5	-98.0	GRA	Torn 2006b
US-ARM	2003	2012	36.6	-97.5	CRO	Fischer et al. 2007
US-Blo	1997	2007	38.9	-120.6	ENF	Goldstein et al. 2000
US-Cop	2001	2007	38.1	-109.4	GRA	Bowling 2007
US-EML	2008		63.9	-149.3	OSH	Belshe et al. 2012
US-GBT	1991	2006	41.4	-106.2	ENF	Massman 2006
US-GLE	2004	2014	41.4	-106.2	ENF	Frank et al. 2014
US-Goo	2002	2006	34.3	-89.9	GRA	Wilson and Meyers 2007
US-Ha1	1991	2012	42.5	-72.2	DBF	Urbanski et al. 2007
US-Ho2	1999		45.2	-68.7	ENF	Hollinger et al. 1999
US-Ho3	2000		45.2	-68.7	ENF	Hollinger et al. 1999
US-IB2	2004	2011	41.8	-88.2	GRA	Matamala 2018

US-KFS	2007		39.1	-95.2	GRA	Brunsell 2018a
US-Kon	2006		39.1	-96.6	GRA	Brunsell 2018b
US-KS2	2003	2006	28.6	-80.7	CSH	Powell et al. 2006
US-Lin	2009	2010	36.4	-119.8	CRO	Fares 2010
US-LPH	2002		42.5	-72.2	DBF	Hadley 2018
US-Me2	2002	2014	44.5	-121.6	ENF	Thomas et al. 2009
US-Me3	2004	2009	44.3	-121.6	ENF	Vickers et al. 2009
US-Me6	2010		44.3	-121.6	ENF	Ruehr et al. 2012
US-MMS	1999		39.3	-86.4	DBF	Schmid et al. 2000
US-Mpj	2007		34.4	-106.2	OSH	Litvak 2018a
US-MRf	2005		44.6	-123.6	ENF	Law 2018
US-Ne1	2001		41.2	-96.5	CRO	Verma et al. 2005
US-Ne2	2001		41.2	-96.5	CRO	Verma et al. 2005
US-Ne3	2001		41.2	-96.4	CRO	Verma et al. 2005
US-NR1	1998		40.0	-105.5	ENF	Monson et al. 2002
US-Oho	2004	2013	41.6	-83.8	DBF	Noormets et al. 2008
US-PFa	1995		45.9	-90.3	MF	Desai et al. 2015
US-Prr	2010	2014	65.1	-147.5	ENF	Nakai et al. 2013
US-Ro2	2003	2017	44.7	-93.1	CRO	Baker and Griffis 2017
US-SRC	2008	2014	31.9	-110.8	OSH	Kurc 2018
US-SRG	2008	2014	31.8	-110.8	GRA	Scott et al. 2015
US-SRM	2004	2014	31.8	-110.9	WSA	Scott et al. 2009
US-Sta	2005	2009	41.4	-106.8	OSH	Ewers and Pendall 2009
US-Syv	2001		46.2	-89.3	MF	Desai et al. 2005
US-Ton	2001		38.4	-121.0	WSA	Fischer et al. 2007
US-Twt	2009	2017	38.1	-121.7	CRO	Hatala et al. 2012
US-UMB	2000		45.6	-84.7	DBF	Gough et al. 2008
US-UMd	2007		45.6	-84.7	DBF	Gough et al. 2018
US-Var	2000		38.4	-121.0	GRA	Fischer et al. 2007
US-WCr	1999		45.8	-90.1	DBF	Cook et al. 2004
US-Whs	2007		31.7	-110.1	OSH	Scott et al. 2015
US-Wi1	2003	2003	46.7	-91.2	DBF	Chen 2003a
US-Wi2	2003	2003	46.7	-91.2	ENF	Chen 2003b
US-Wi3	2002	2004	46.6	-91.1	DBF	Chen 2005a
US-Wi5	2004	2004	46.7	-91.1	ENF	Chen 2004
US-Wi6	2002	2003	46.6	-91.3	OSH	Chen 2003c
US-Wi7	2005	2005	46.6	-91.1	OSH	Chen 2005a
US-Wi9	2004	2005	46.6	-91.1	ENF	Chen 2005b
US-Wjs	2007		34.4	-105.9	OSH	Litvak 2018b
US-Wkg	2004	2014	31.7	-109.9	GRA	Scott et al. 2010

5. Data Acquisition, Materials, and Methods

CASA Description

The modeling approach is based on the CASA biogeochemical model (Potter et al. 1993; Randerson et al. 1996). In CASA, NPP is calculated with a light use efficiency model driven by the absorbed fraction of photosynthetically active radiation ($fPAR$) and scaled by maximum light use efficiency (E_{max}), temperature scalar (T_{NPP}) and moisture stresses (W_{NPP}) at spatial location (x, y) and time (t) (Eq. 1). W_{NPP} was derived based on a ratio of estimated evapotranspiration to potential evapotranspiration, varying from 0.5 (arid ecosystem) to 1 (very wet ecosystem). T_{NPP} is defined as $T_1 \times T_{2low} \times T_{2high}$. T_1 reflects the empirical observation that plants in very cold habitats typically have low maximum growth rate (Eq. 2). T_2 reflects the concept that the efficiency of light utilization should be depressed when plants are growing at temperatures displaced from their optimum (Eq. 3 and 4). T_2 has an asymmetric bell shape that falls off more quickly at high than at low temperatures. T_{opt} is defined as the air temperature in the month when the NDVI or LAI reaches its maximum for the year.

$$NPP(x, y, t) = fPAR(x, y, t) \cdot PAR(x, y, t) \cdot E_{max}(x, y) \cdot T_{NPP}(x, y, t) \cdot W_{NPP}(x, y, t) \quad (1)$$

$$T_1 = 0.8 + (0.02 \times T_{opt}) - 0.0005 \times T_{opt}^2 \quad (2)$$

$$T_{2low} = \frac{1}{1 + e^{0.2 \times (T_{opt} - 10 - T(x, t))}} \quad (3)$$

$$T_{2high} = \frac{1}{1 + e^{0.3 \times (T(x, t) - 10 - T_{opt})}} \quad (4)$$

On a monthly time step, NPP is allocated to leaves, roots and wood (Eq. 5), with a default allocation ratio of 1:1:1. Each of these pools has a turnover time that specifies the rate at which carbon moves to litter pools (surface fine litter, soil fine litter, coarse woody debris). Carbon in the litterfall pool is either transferred to the microbial and soil organic matter pools or decomposed during the process. Decomposition of dead pool (e.g. litter and soil organic pools) releases carbon, i.e. heterotrophic respiration (R_h), as Eq. 6:

$$NPP = [f_{leaf}(x, y) + f_{wood}(x, y)(F_{above}(x, y) + F_{below}(x, y)) + f_{root}(x, y)] \cdot NPP \quad (5)$$

$$Rh(x, y, t) = \sum_{i=1}^p C_i(x, y, t) \cdot k_i(x, y) \cdot W_{resp}(x, y, t) \cdot T_{resp}(x, y, t) \cdot D_\varepsilon(x, y) \quad (6)$$

where p is the number of pools, C_i is the carbon content of pool i , k_i is the pool-specific decay rate constant, W_{resp} and T_{resp} are the effect of soil moisture and temperature on decomposition, and D_ε is microbial carbon decomposition efficiency. The effect of temperature on soil carbon fluxes (T_{resp}) is treated uniformly as an exponential (Q10) response:

$$T_{resp}(x, y, t) = Q_{10}^{(T(x, y, t) - 30)/10} \quad (7)$$

where Q_{10} is the multiplicative increase in soil biological activity for a 10 °C rise in soil temperature and $T(x, t)$ is monthly averaged air temperature.

NEP is computed as:

$$NEP(x, y, t) = NPP(x, y, t) - R_h(x, y, t) \quad (8)$$

A carbon use efficiency of 0.5 was assumed such that gross primary productivity (GPP) is 2×NPP. Correspondingly, total ecosystem respiration (RECO) would become the sum of NPP and Rh, and net ecosystem exchange (NEE) is equal to RECO – GPP. The data used as input to the model are listed in Section 4.

For 3-hourly simulation, the North American Regional Reanalysis (NARR) 3-hourly (UTC) air temperature (T_{air}) and downward shortwave radiation ($DWSW$) was used to further downscale monthly carbon fluxes. Monthly estimates were distributed to 3-hourly temporal scale with a simple assumption of dependence on light for GPP and temperature for RECO (Olsen and Randerson 2004; Fisher et al. 2016).

Pruned Parameter Sets for Generating L1 Data

Table 2. Perturbed parameter sets used to generate CASA ensemble L1 product.

#Para	1	2	3	4	5	6	7	8	9	10	11	12
DT_{opt}	0	-2	2	0	-2	2	0	-2	2	0	-2	2
E_{max}	0.25	0.25	0.25	0.5	0.5	0.5	0.75	0.75	0.75	1	1	1
Q_{10}	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
#Para	13	14	15	16	17	18	19	20	21	22	23	24
DT_{opt}	0	-2	2	0	-2	2	0	-2	2	0	-2	2
E_{max}	0.25	0.25	0.25	0.5	0.5	0.5	0.75	0.75	0.75	1	1	1
Q_{10}	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
#Para	25	26	27	28	29	30	31	32	33	34	35	36
DT_{opt}	0	-2	2	0	-2	2	0	-2	2	0	-2	2
E_{max}	0.25	0.25	0.25	0.5	0.5	0.5	0.75	0.75	0.75	1	1	1
Q_{10}	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
#Para	37	38	39	40	41	42	43	44	45	(Para 37 - 45 for cropland only)		
DT_{opt}	0	-2	2	0	-2	2	0	-2	2			
E_{max}	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25			
Q_{10}	1.4	1.4	1.4	1.2	1.2	1.2	1.6	1.6	1.6			

DT_{opt} is the adjustment of optimal temperature.

Pruned Parameter Sets for Generating L2 Data

To further constrain E_{max} for each biome type, carbon flux measurements during the growing seasons from AmeriFlux and FLUXNET datasets were used to infer the appropriate biome-specific range of E_{max} according to the light use efficiency model in CASA (Eq. 12). As flux sites are broadly distributed across space, we defined the growing season as months when the NPP is higher than averaged NPP within each year.

$NPP_{obs, in}$ is the inferred NPP value from flux measurement, $fPAR$ is derived from MOD15A2H at each flux site, and PAR_{obs} is the

ground-measured at each site (for sites lacking PAR observation, we used NLDAS-2 instead). NPP scalars (T_{NPP} and W_{NPP}) are computed using ground-measured precipitation and air temperature (for sites lacking these observations, we used data sampled from PRISM at corresponding flux tower locations).

Table 3. Statistics of E_{max} inferred from flux tower data for each biome type to generate L2 data.

Biome type	WSA	CRO	DBF	ENF	MF	GRA	CSH	OSH
Grow Seas Avg	0.51	1.01	0.69	0.64	0.51	0.69	0.47	0.4
Grow Seas STD	0.04	0.37	0.15	0.23	0.29	0.29	0.29	0.15
Emax Samples for full Uncert. [E_1, E_2, E_3]	[0.25, 0.50, 0.50]	[0.75, 1.00, 1.25]	[0.50, 0.75, 0.75]	[0.50, 0.75, 0.75]	[0.25, 0.50, 0.75]	[0.50, 0.75, 1.00]	[0.25, 0.50, 0.75]	[0.25, 0.50, 0.50]

Table 4. Perturbed parameter sets with constrained PFT-specific E_{max} used to generate CASA ensemble L2 product.

#Para	1	2	3	4	5	6	7	8	9
DT_{opt}	0	-2	2	0	-2	2	0	-2	2
E_{max}	E_1								
Q_{10}	1.4	1.4	1.4	1.2	1.2	1.2	1.6	1.6	1.6
#Para	10	11	12	13	14	15	16	17	18
DT_{opt}	0	-2	2	0	-2	2	0	-2	2
E_{max}	E_2								
Q_{10}	1.4	1.4	1.4	1.2	1.2	1.2	1.6	1.6	1.6
#Para	19	20	21	22	23	24	25	26	27
DT_{opt}	0	-2	2	0	-2	2	0	-2	2
E_{max}	E_3								
Q_{10}	1.4	1.4	1.4	1.2	1.2	1.2	1.6	1.6	1.6

DT_{opt} is the adjustment of optimal temperature.

Ecoregional Sampling of L2 Ensemble for Generating L2B Data

In addition to the L2 ensemble product, L2B data were included which is the random sampling of L2 ensemble (27 members) based on the ecoregion maps. The L2B file, entitled with "CASA_L2B_Ensemble**", has 10 members that randomly sampled L2 ensemble member (i.e., parameter set) for each Level-3 ecoregion for both North America and CONUS. Considering the data volume, only GPP and NEE were included for the L2B data. More information about ecoregion maps can be found at <https://www.epa.gov/eco-research/ecoregions>. L1-3 ecoregion maps are available for NA; L1-4 ecoregion maps are available for CONUS. The supplement contains an R script and converted ecoregion files (*.nc format) in order for users to generate the random sample for the ecoregion maps at other levels or change the number of samples.

Diver Data

Model input	Dataset	Spatial resolution	Time resolution	Reference
Conterminous US				
fPAR	MCD15A2H	463.31 m	8-day	Myneni et al. (2015)
Tree and herb covers	MOD44B	250 m	Yearly	Dimiceli et al. (2015)
Precipitation and T_{air}	PRISM	30 "	Monthly	PRISM Climate Group (2016)
DWSW and DWLW ¹	NDLAS-2 Forcing	0.125 °	Monthly	LDAS (2016)
DWSW ¹ and T_{air}	NARR	32 km	3-hourly	NCEP (2005)
Biome type	National Forest Type	250 m	NA	Ruefenacht et al. (2008)
	NAFD	30 m	NA	Goward et al. (2012)
	MOD12Q1 IGBP	463.31 m	Yearly	Friedl et al. (2010)
Clay, silt, sand Fractions	CONUS-Soil	1000 m	NA	Miller and White (1998)
North America				
fPAR	MCD15A2	1000 m	8-day	Myneni et al. (2002)
Tree and herb covers	MOD44B	250 m	Yearly	Dimiceli et al. (2015)
Precipitation, T_{air} , DWSW, and DWLW ¹	NARR	32 km	Monthly	NCEP (2005)

DWSW and T _{air}	NARR	32 km	3-hourly	NCEP (2005)
Biome type	National Forest Type	250 m	NA	Ruefenacht et al. (2008)
	NAFD	30 m	NA	Goward et al. (2012)
	MOD12Q1 IGBP	463.31 m	Yearly	Friedl et al. (2010)
Clay, Silt, Sand Fractions	NACP MsTMIP Soil Map	0.25 °	NA	Liu et al. (2014)

¹ DWSW and DWLW are downward shortwave and longwave radiation, respectively.

Guide to Using the R script for Temporal Downscaling

An R script and associated data are provided to generate the L2 ensemble at users' end for two spatial domains, conterminous United States and North America. The R script uses three packages, including *ncdf4*, *rgdal*, and *raster*. On the users' end,

1. Users determine which ecoregional level to work with by defining "EcoregionLevel"; L1-3 data are available for North America; L1-4 data are available for the conterminous US; shapefiles of different levels from the United States Environmental Protection Agency (<https://www.epa.gov/eco-research/ecoregions>) are included that can be called by the script;
2. Users define the spatial domain of the random ecoregional sampling: CONUS or NA;
3. Users set the path of ecoregion files (e.g., if users are working with L3 ecoregions for CONUS, the ecoregion file is CONUS_Eco_Level3_CASAgri.nc4);
4. Users define the number of L2B sampling by change "L2BMembers";
5. Users set the path of L2 files by change "L2Path";
6. Users select the year(s) ("SampleYear") for sampling;
7. Users select the carbon flux(es) ("CFluxes") to be sampled;
8. If users would like to use the previous random samples for another sampling of the same spatial domain, change "Saved_EcoregionRandSamp" to 1 and move the file "EcoregionRandSamp_**.txt" to the output path. This file should be found in the output path when "Saved_EcoregionRandSamp" is set to 0.
9. Users set the output path ("outputPath").

Questions on using this script can be sent to yuzhou2@clarku.edu or cwilliams@clarku.edu.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[ACT-America: Gridded Ensembles of Surface Biogenic Carbon Fluxes, 2003-2019](#)

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

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8. Dataset Revisions

Version	Release Date	Description
1.1	2020-09-27	Add 2019 data for L2 ensemble for the Conterminous US and North America
1.0	2020-02-21	Initial release of data



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All Datasets

Submit Data

Submit Data Form
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Data Authorship Policy
Data Publication Timeline
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THREDDS
SDAT
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